

CLAIMS

We claim:

- 5 1. An intake manifold assembly comprising:
 an intake manifold including an intake passageway; and
 a fuel injector in communication with the intake passageway, at
least a portion of the fuel injector being molded into the intake manifold.
- 10 2. The intake manifold assembly of claim 1, wherein the intake
manifold has a fuel passageway defined therein, the fuel passageway being in
communication with the fuel injector.
- 15 3. The intake manifold assembly of claim 2, wherein the fuel injector
is entirely molded into the intake manifold such that liquid fuel transferred from
the fuel passageway to the intake passageway via the fuel injector, and
hydrocarbon emissions resulting from the transfer of fuel, are substantially
prevented from leaking outside the intake manifold.
- 20 4. The intake manifold assembly of claim 2, further comprising a fuel
rail defining the fuel passageway, at least a portion of the fuel rail being molded
into the intake manifold.

5. The intake manifold assembly of claim 4, wherein the fuel passageway is in communication with a fuel inlet of the fuel injector, and wherein an interface between the fuel rail and the fuel inlet of the fuel injector is molded into the intake manifold.

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6. The intake manifold assembly of claim 5, wherein the fuel injector is coupled to the fuel rail without using a seal adjacent the interface.

7. The intake manifold assembly of claim 4, wherein the fuel rail includes a fuel rail inlet extending from the intake manifold.

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8. The intake manifold assembly of claim 1, wherein the intake manifold includes:

a middle shell;

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an upper shell coupled to an upper portion of the middle shell; and

a lower shell coupled to a lower portion of the middle shell.

9. The intake manifold assembly of claim 8, wherein a combination of the middle shell and the lower shell defines in part a plenum.

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10. The intake manifold assembly of claim 8, wherein a combination of the upper shell and the middle shell defines in part the intake passageway.

11. The intake manifold assembly of claim 8, wherein the fuel injector is at least partially molded into the middle shell.

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12. The intake manifold assembly of claim 1, further comprising an electrical connector coupled to the fuel injector, the electrical connector being at least partially molded into the intake manifold.

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13. The intake manifold assembly of claim 1, wherein a fuel outlet of the fuel injector is in communication with the intake passageway to selectively deliver fuel to the intake passageway, and wherein the fuel outlet is molded into the intake manifold.

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14. The intake manifold assembly of claim 13, wherein the fuel outlet of the fuel injector is molded into the intake manifold without using a seal adjacent the fuel outlet.

15. A method of manufacturing an intake manifold assembly, the method comprising:

providing a fuel injector;

inserting the fuel injector into a mold cavity; and

5 forming at least a portion of an intake manifold in the mold cavity such that at least a portion of the fuel injector is molded into the intake manifold.

16. The method of claim 15, further comprising forming a fuel passageway in the intake manifold.

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17. The method of claim 16, wherein forming the fuel passageway includes molding at least a portion of a fuel rail into the intake manifold, the fuel rail defining the fuel passageway.

15 18. The method of claim 15, further comprising:
providing a fuel rail; and
coupling the fuel injector to the fuel rail.

19. The method of claim 18, wherein the fuel injector is coupled to the
20 fuel rail without using a seal between the fuel injector and the fuel rail.

20. The method of claim 18, wherein coupling the fuel injector to the fuel rail includes one of laser welding, TIG welding, and brazing.

21. The method of claim 18, wherein inserting the fuel injector into the mold cavity includes inserting the fuel rail into the mold cavity such that at least a portion of the fuel rail is molded into the intake manifold.

5 22. The method of claim 15, wherein forming at least a portion of the intake manifold includes insert molding the entire fuel injector into the manifold such that liquid fuel provided to the fuel injector, liquid fuel discharged by the fuel injector, and hydrocarbon emissions resulting from evaporation of the fuel provided to the fuel injector and the fuel discharged by the fuel injector are
10 substantially prevented from leaking outside of the intake manifold.

 23. The method of claim 15, wherein forming at least a portion of the intake manifold includes
 forming a middle shell;
15 forming an upper shell; and
 coupling the upper shell to the middle shell to define at least part of
an intake passageway.

 24. The method of claim 23, wherein coupling the upper shell to the
20 middle shell includes one of welding, bonding, and using a snap-fit engagement.

25. The method of claim 23, further comprising:
forming a lower shell; and
coupling the lower shell to the middle shell to define at least part of
a plenum.

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26. The method of claim 25, wherein coupling the lower shell to the
middle shell includes one of welding, bonding, and using a snap-fit engagement.

27. The method of claim 15, wherein the fuel injector is molded into
10 the intake manifold without using a seal between the fuel injector and the intake
manifold.

28. The method of claim 15, further comprising:
coupling an electrical connector to the fuel injector; and
15 molding at least a portion of the electrical connector into the intake
manifold.

29. The method of claim 15, further comprising:

providing a fuel rail;

coupling the fuel injector to the fuel rail;

providing an electrical connector;

5 coupling the electrical connector to the fuel injector; and

wherein forming at least a portion of the intake manifold further includes molding substantially the entire fuel injector, at least a portion of the fuel rail, and at least a portion of the electrical connector into the intake manifold such that liquid fuel provided to the fuel injector, liquid fuel discharged by the fuel
10 injector, and hydrocarbon emissions resulting from evaporation of the fuel provided to the fuel injector and the fuel discharged by the fuel injector are substantially prevented from leaking outside of the intake manifold.

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30. An intake manifold assembly comprising:
an intake manifold having an intake passageway; and
a fuel rail assembly including
a fuel injector having a fuel inlet and a fuel outlet, the fuel
5 outlet being in communication with the intake passageway;
a fuel rail defining a fuel passageway in communication
with the fuel inlet; and
an electrical connector coupled to the fuel injector;
wherein the electrical connector is at least partially molded into the
10 intake manifold; and
wherein an interface between the fuel passageway and the fuel inlet
is molded into the intake manifold, and wherein the fuel outlet is molded into the
intake manifold such that liquid fuel transferred from the fuel passageway to the
intake passageway via the fuel injector, and hydrocarbon emissions resulting from
15 the transfer of fuel, are substantially prevented from leaking outside the intake
manifold.

31. The intake manifold assembly of claim 30, further comprising a
second fuel rail assembly at least partially molded into the intake manifold.

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32. An engine assembly comprising:
an engine having a cylinder head; and
an intake manifold coupled to the cylinder head, the intake manifold defining

5 an air path for providing intake air to the cylinder head;
a fuel path for providing fuel to the cylinder head; and
an electrical path for providing power to a fuel injector;
wherein each of the air path, the fuel path, and the electrical path
are at least partially molded into the intake manifold.

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33. The engine assembly of claim 32, wherein the fuel path includes a fuel injector, the fuel injector being at least partially molded into the intake manifold.

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34. The engine assembly of claim 32, wherein the fuel path includes a fuel passageway defined in the intake manifold.

35. The engine assembly of claim 34, wherein the fuel passageway is defined by a fuel rail at least partially molded into the intake manifold.

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36. The engine assembly of claim 32, wherein the air path includes an intake passageway formed during molding of the intake manifold.

37. The engine assembly of claim 32, wherein the electrical path
25 includes a bus-bar at least partially molded into the intake manifold.